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JPRS: 3002

15 February 1960

COMMUNIST CHINA'S PROGRESS IN INDUSTRIAL TECHNIQUES  
AND PRODUCTION IN DECADE AFTER LIBERATION

[Translation]

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## I. A DECADE OF LEAP-FORWARD DEVELOPMENT IN RADIO INDUSTRY TECHNIQUES

Tien-hsin K'ao-hsueh  
[Telecommunications Science],  
No 9, 27 September 1959, Peiping  
Pages 2-4  
Chinese, per

Lo Pei-lin

In the 10 years since the establishment of our country, under the brilliant leadership of the party and the government and with the great effort of the workers and the assistance of the Soviet Union and other socialist nations, we have already established a complete radio industry of definite dimensions -- including the radio, telecommunications, and electronics industries. It includes modern productive enterprises and scientific research laboratories which are capable of designing the technical schools and design structure necessary for modern industrial plants. At the end of 1958, product variety had increased 74 fold and productivity had also increased greatly. The great new labor force attained the mastery of modern techniques and many enterprises have been equipped with many different types of modern equipment. We can now successfully design and manufacture many more modern products. In the fields of electron tubes and electronic parts, we are basically self-sufficient. In the field of scientific and technical research, we have become more creative and have attained great results in many cases. The road our industry has traveled in the last 10 years truly is an interesting one.

### A. The Restoration and Development of the Radio Industry

Prior to the liberation, the radio industry was extremely weak. Most prominent in this field were four radio plants and one wire communications plant, all of which were managed by personnel from imperialist countries. Even these were of small size, were poorly equipped, had low production technical levels, and could only copy electron tubes and important elements imported from foreign nations. There was only one piece of equipment capable of manufacturing electron tubes available in the whole country, and it had been imported. These enterprises were solely the tools of the imperialist and the capitalist class for economic exploitation. Besides these enterprises, there were also a few privately managed radio plants of about family-size. They were under pressure from the imperialists and capitalist class. It was difficult for them to expand. Furthermore, they lacked equipment and had low technical levels. On the other hand, in the liberated areas the military, under the guidance of the party, established

communications equipment and materials plants under difficult conditions for the repair and limited manufacture of electronics equipment. At that time conditions were difficult everywhere, and everything was used in support of the activities on the front lines. Excluding a few cadres which could be of future use in the radio industry, little manufacturing capability was available.

During the restoration period of our national economy, we actively supported the restoration and development of the radio industry. The mass movements of the people's revolution and the industrial revolution greatly aroused the enthusiasm of the workers and proved to be profitable in the development of the industry. Many enterprises installed new equipment and strengthened their work forces. In support of the "resist America" struggle, we designed communications equipment according to the production conditions then available. It was the first time in our history that punch techniques and pressure casting, as well as automatic receivers, were put into production. Equipment for the production of electron tubes began to appear, which in turn began to solve the problems in the supply of these parts. Naturally, compared to the development of other of our industries during the same period, design and technical levels were low and quality of materials used was low, consequently product quality was low. However, since the liberation, technical levels have risen and product variety and quantity has increased. This has certainly smashed the old concept of only being able to assemble and repair.

#### B. Capital Construction and Technical Reform During the First Five-Year Plan

During the First Five-Year Plan period, the radio industry was engaged in large scale construction, establishment of a technical basis, strengthening technical leadership, and over-all technical reform.

Electron tubes and elements are the technical basis of the radio industry and necessarily must be at the front of any industrial construction. Therefore, during the period of the First Five-Year Plan, construction of production capabilities for electron tubes and elements was of first priority. The Peiping Electron Tube Plant, the North China Radio Equipment and Materials Plant, and the Southwest Radio Equipment and Materials Plant were constructed with the assistance of the Soviet Union, East Germany, and other socialist countries. The manufacture of electron tubes and elements is quite complex. Not only do they require large amounts of precision machine processing, but also many different special techniques such as high-vacuum techniques, precision heat-treatment of glass, hermetically sealing of glass to metal, cathode-ray equipment, electron tube measurement, manufacture of radio

porcelain, etc. These techniques took years for many other nations to master; however, with the assistance of the Soviet Union and other brother nations, we have rapidly attained the control of these complex techniques and also have mastered the use of modern equipment.

During the period of economic restoration, we were limited to technically simple communications equipment, however, during the period of the First Five-Year Plan, we constructed a few enterprises which had been lacking and attained control of many new techniques, so that the variety of products increased considerably. Included in this new equipment was navigation equipment, automatic telephone switchboards, ray counting instruments, high-frequency heating equipment, marine and communications equipment, broadcasting equipment, motion picture sound equipment, etc.

The construction of modern radio plants has created a new look, technically speaking, in our radio industry. Of similarly importance is the expansion of old plants, the increase of modern equipment and the especially greatly increased capability to produce modern tools. Of even more importance is the increased study of Soviet advanced experiences and the trial production of modern technical products. Production capabilities and technical levels have also been raised through the mastery of new techniques. We have greatly reduced the use of nickel through the adoption of the use of porcelain and other techniques. The standardization of radio parts has not only raised their quality, but also increased their interchangeability. We have set up inspection offices to control quality. Trial production and production preparation have further improved quality during regular production. With the assistance of brother plants within China we have become self-sufficient in many necessary raw materials. The development of new materials has also enabled us to establish initial conditions for micro-wave techniques.

In 1956, during the drafting of a 12-year plan for the development of science and technology, the importance of radio and electronic techniques was brought to light. The long-range development of radio and electronics was planned to greatly implement the development of the radio industry.

During the period of the First Five-Year Plan, the radio industry attained a great technical renovation. We destroyed the concept of only being able to assemble and repair radio equipment held during the restoration period, so that now we have an industry capable of manufacture and scientific research. Privately managed radio plants have become socialized according to the national plan.

C. Scientific and Technical Achievements Attained Through the Mass  
Movements of the Great Leap Forward by the Radio Industry

After the second session of the Eighth All-China Communist Party Congress held during 1958, the workers of the radio industry aiming toward the lofty goals set by the party reached greater heights in the great leap forward of production. During July of this same year, the Radio Industry Department opened a scientific research and product design conference, which issued many ways in which product variety could be expanded. It further developed the lofty aims for scientific research and technology. Mass movements were also greatly brought into play. "Thought liberation," enthusiasm, realistic leadership, destruction of superstition, etc., by workers and leadership cadre alike created many records. By the end of 1958, there had been 178 products, 183 types of electron tubes, and 177 elements trial manufactured. The total of new trial products was 3.08 times the total for the entire First Five-Year Plan period. Of this number, 21 percent were domestically designed. There also were 266 new techniques put into operation and numerous mass-inspired rational proposals which were adopted. Before 1959 was half over we had domestically designed our first television station comparatively complex, modern radio equipment, "tan-tai-tuan-po" [literally--single-path short wave] radio station, special grade broadcasting receivers, and carrier-wave communications equipment. We had also successfully manufactured high-speed, electronic computers (in conjunction with Academia Sinica); modern, portable radio stations; aviation navigation equipment, complex radio location equipment, television receivers, various types of radio and electronics measuring instruments, etc. In the fields of electron tubes, elements and materials, we had created capacitors capable of resisting 120 degrees C., metal-covered resistors, various other types of resistors, etc. In the field of techniques we expanded the uses of such materials as plastics, aluminum, cold-formed molds, etc.

In our great leap forward our engineers and technical workers as well as ordinary workers attained new levels in science and technology. Through their efforts the ranks of the technologists within this industry were strengthened. Such accomplishments will be of great future use to the radio industry in its development.

The great leap forward further produced the following achievements: value of production was 2.5 times that of 1957, labor productivity was up 37 percent, scientific and technical levels were higher, and the working force was increased over 100 percent.

Although great successes were attained during the great leap forward of 1958, emphasis by some persons on "more and quicker" instead of on "better and cheaper" was brought to light. This shortcoming is only temporary and has already been greatly overcome. The workers of the radio industry are ever opposing rightist conservatism.

#### D. Our Glorious Future.

In the last 10 years the accomplishments of the radio industry in the scientific and technical fields have been tremendous. Our progress has been equal to that accomplished by other countries in 20 to 30 years. Despite our successes we still must continue our development, as there still remain weak points and blank spots in our technology. Other points which must be emphasized are self-sufficiency in radio equipment and elements; mechanization of electron tube manufacturing equipment; reduction of size, weight and power consumption of communication equipment; mechanization of communications equipment; development of rapid automatic switchboards; development of techniques in high-speed calculating, automatic control, remote control, remote measurement, and remote supply; more rational use of domestic raw materials; conservation of materials; use of substitute materials; control of new techniques; and lowering of costs of production; etc.

The study of the advanced experiences of the USSR and other socialist nations during the First Five-Year Plan by the radio industry enabled us to not walk many twisted paths, but to rapidly raise our technical levels. Such study in the future is a principle which we cannot deviate from. We should also utilize the technical accomplishments of the capitalist nations, as well. Since we have our own peculiar technical, economic and raw material supply conditions, we must strive toward domestic design and domestic manufacture, as determined by these conditions.

The need for electron tubes, elements, and materials -- the basis of the radio industry -- will require great efforts in these fields if we are to continue our forward progress. Our task is great and glorious. Continued great efforts will enable our radio industry to enter the ranks of the world's most advanced.

## II. A BRILLIANT DECADE FOR METAL-CUTTING MACHINE TOOLS

K'io hsueh Ta-chung

[Popular Science],

No 10, 10 October 1959, Paiping

Pages 409-410

Chinese, per

Metal-cutting machine tools (herein simplified to machine tools) are machines to manufacture machines. In a modern machine industry, metal cutting processing occupies a very great percentage of the total work expended. In a plant engaged in "batch" production, 40-60 percent of the work is metal-cutting processing, while in a plant engaged in mass production, 15-35 percent of the work is metal-cutting processing. In the general machinery plant, of the major technical equipment, an average of 60-80 percent of the total number of machines are machine tools. Owing to the present scientific and technical progress, the products of the machinery industry are increasing daily. As the products of the various sectors of the machinery industry are varied, the machine tool industry must supply various types, sizes and characteristically dissimilar pieces of technical equipment. For example, the gears used in manufacturing steam turbines are 2,000-3,150 millimeters in size and must be held within tolerances of 0.042 millimeters. Such a product requires a highly precise gear hobbing machine. To manufacture the base for a 50,000-kilowatt hydraulic turbine, which is 12-meters over-all and which weighs about 300 tons, requires the use of a huge vertical lathe. There are other products which require the use of either high efficient or highly precise machine tools. At the same time, in order to raise labor productivity, lower costs, and improve working conditions, an unceasing revision of work techniques must be carried on. Examples of this are high-speed cutting, multi-cutter processing, automatic loading of parts, automatic measuring, remote control, automatic production lines, etc. Therefore, the machinery industry wants the machine tool industry to raise its technical level and expand the variety of its products in pace with the development of these new techniques so that the needs of the machinery industry will be satisfied.

Prior to the liberation, old China did not have an independent machine tool industry. At that time only a few plants capable of repairing machine tools undertook the manufacture of a few machine tools. Moreover these machine tools were backward, simple and of low quality. For example, prior to the liberation in Shanghai, the best gear-driven lathe which could be manufactured had a speed of only 600 revolutions per minute, was inconvenient to operate, was inefficient,



and could not make large cuts at a time. At the same time the parts which made up the lathe were crude, the gears were not precise, the castings were not hard enough, parts that required quenching were not quenched, etc. The parts produced on such a lathe had a short service life and could not be depended upon for accuracy.

### Varied Products, Brilliant Successes

In the 10-year period since the liberation, our nation's machine tool industry has already progressed toward a completely independent system. In 1958, output reached 50,000 units of more than 400 different varieties. Within this number were universal, heavy-duty, precise, and highly efficient products to overcome the needs of the giant scale of our national construction. Moreover, independent design of machine tools was undertaken and the technical level of the structure of our machine tools has already been raised to modern standards.

During the period of the First Five-Year Plan, a total of over 200 types of products were produced, or five times the amount during the restoration period. A degree of about 80 percent self-sufficiency was attained in machine tools as regards to number. During that period, excluding the batch production of medium- and small-scale universal machine tools, such machines as multi-cutter and semi-automatic lathes, single-spindle automatic lathes, multi-spindle automatic lathes, metal boring machines, plano-milling machines, combination machine tools, and a certain number of special machine tools could be produced. The establishment of a complete system of machine tool manufacture has been progressively carried out to supply a material basis for newly established enterprises or technically reformed old enterprises within the machinery industry and also so that the machine tool industry, itself, might completely change its backward characteristics.

In 1958, the first year of the Second Five-Year Plan, the machine tool industry made a "flying leap forward" on the basis of the high tide of the great leap forward movement. In just one year the variety of new products developed was equal to about 60 percent of the total amount for the entire First Five-Year Plan period.

At present, in the field of heavy-duty machine tools, we can already process parts on 3.4 meter vertical lathes. The weight of the parts can reach even to 20 tons. Parts can be planed to a thickness of 3 meters. Milling machines have beds capable of handling parts 14 meters long. Parts with diameters of 1,250 millimeters can be handled on horizontal lathes and the weight of these same parts can reach 30 tons.

In the field of precision machine tools, already last year a jig-boring machine with a table of 450 x 280 millimeters and with cutters of a maximum of 60 millimeters was trial produced. The movement of the work table is controlled by an induction-type electric motor, with it the exact position of the table can be predetermined. The machine tool is calibrated in 0.001 millimeter increments. At present another jig-boring machine with a table of 1,250 x 630 millimeters has been successfully trial manufactured. We also have a gear grinding machine capable of handling gears up to 250 millimeters. It can grind slotting cutters, shaving cutters, and standard gears. Parts ground on the machine can be held to tolerances of 0.003 millimeters. A thread grinding machine capable of handling parts up to 200 millimeters has also been successfully trial manufactured. It can grind both internal and external threads to a tolerance of 0.003 millimeters.

Grinding machines, the machines so necessary for a nation's modern machinery industry, were developed in the last 10 years. Their ability to process parts and their degree of preciseness has been greatly developed. Now, when one walks into an automobile, tractor, airplane, machinery, or bearing-manufacturing plant, many machines will be issuing forth steel chips but only the grinding machines will be spitting forth a shower of sparks. When the processing of the parts are completed their appearance is comparable to that of a mirror. In measuring the parts for dimensional accuracy, optical instruments must be used. As science and technology increase daily and the speed of machinery increases, the use of grinding machines in our national economy becomes more and more apparent.

In the field of high efficiency machine tools, we already have a series of single-spindle and multi-spindle automatic lathes as well as multi-cutter semi-automatic lathes. For example, in processing bar stock of diameters up to 7 millimeters, we have single-spindle automatic lathes with a main shaft speed of 6,300 revolutions per minute, which can process the part to a tolerance of 0.005 millimeters and a surface finish of VVW8. We also have six-spindle lathes capable of handling parts up to 50 millimeters and four-spindle automatic lathes capable of handling parts up to 65 millimeters. There also is a universal semi-automatic lathe capable of handling parts up to 490 millimeters. This machine has hydraulically controlled cutters. It is highly efficient and has a main electric motor of 28-kilowatt capacity.

In the fields of combination machine tools and special machine tools we can produce several large-scale, complex products. For example, the two-surface, horizontal-type, combination boring machine used on

the main shaft box for a C616-type ordinary lathe has a total of 24 spindles and utilizes 40 cutters at the same time. Compared to an ordinary boring machine, it has an efficiency 7-8 times higher. There also are roll grinders and roll lathes capable of handling rolls with diameters up to 1,000 millimeters and lengths up to 10 meters.

In the field of electro-processing machine tools, we have such products as electro-spark forming machines, electro-spark boring machines, and universal electro-spark processing machine tools. For example a semi-automatic electro-spark boring machine, which can bore holes of 0.15-0.35 millimeter diameter, is used in the mass production of diesel oil injectors for diesel engines. We now have an electro-pulsating forming-boring machine for use in processing the dies in various forging operations.

In the field of electro-forming machine tools, during 1958 we successfully utilized electron tube amplifiers and alternating magnetic amplifiers to control automatic forming milling machines and vertical lathes equipped with electron tube controls. These vertical lathes could not only be used as ordinary vertical lathes, but could also process the complex shaped ring-type parts used on aircraft, automobiles, and rolling stock.

To support agricultural construction, as well as the needs of medium and small-scale enterprises, we also developed various types of simple and convenient-to-operate machine tools. During the great leap forward of 1958, great amounts of machine tools were in demand and since the machine tool industry could not supply all of them, the nationwide "native" machine tool movement was started. This movement brought forth innumerable simple, native machine tools. For example the Shanghai Cheng-t'ou-feng Automobile Repair and Parts Plant solved its lack of "foreign" machine tools by converting an old vertical lathe into a gear-shapping machine. The workers of the Shanghai Heng-hsin Machinery Plant invented a native screw lathe which can process the screws necessary for use on machine tools. It is highly efficient and basically solved the key problem in that plant's production.

#### Future Hopes

Under the directive which makes steel our primary objective and also to satisfy the needs of the steel rolling, coke refining, coal washing, and transportation equipment manufacturing industries, there needs to be a great development of heavy-duty machine tools in the future. Together with the great leap forward of our nation's industry has come an increased need for more products. Since our nation requires a great many bearings and electric motors each year, automation must be

developed along with more highly efficient machine tools. We need to not only develop heavy-duty machine tools, but also the more simple, easy-to-operate, and easy-to-repair machine tools necessary for medium- and small-scale enterprises and agriculture. Although our precision machine tool manufacturing industry has developed rapidly, we must still carry out research into the manufacture of precision machine tools.

...the development of machine tools is a long and arduous task. It requires a high degree of technical innovation and a large amount of investment. In the past, we have made significant progress in the development of machine tools, but there is still a long way to go. We must continue to strengthen our research and development efforts, and we must also pay attention to the training of technical personnel. Only in this way can we ensure the sustainable development of our machine tool industry.

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### III. CONGRATULATORY WISHES ON THE OPENING OF THE SHANGHAI INDUSTRIAL EXHIBIT

Chi-hsieh Chin-tsao

Ho Kuo-sen

[Machine Building]

No 9, 25 September 1959, Shanghai

Pages 4-8

Chinese, per

Our nation is taking a flying leap forward. In step with the progress of our national socialist construction, the industry of Shanghai is also in a flying leap forward. Likewise, the Shanghai machinery manufacturing industry is also in a flying leap forward. The Shanghai Industrial Exhibit is being opened to commemorate the great successes which we have attained.

The walls of the exhibition hall are covered with banners proclaiming such things as: "The total value of production by the Shanghai machine industry in 1958 was 57.5 times that of 1949 and the amount for 1958 showed a 134 percent increase over 1957. The labor productivity rate for 1958 was 8.56 times that of 1949 and the rate for 1958 was 71 [sic] times that of 1957. Over 12,800 different products can already be produced. The machine industry of Shanghai has already successfully completed a 25,000-kilowatt steam turbine, a 2,300-millimeter medium-plate rolling mill, a precision screw grinder, complete sets of thermal instruments, etc. The 240,000 workers of Shanghai are continuing their great leap forward."

The hall is filled with many great, large, precision, and important machine industry products. There are 10 actual products and one model of power-producing machinery, 26 large-scale and numerous small-scale machine tools and tools products, 16 pieces of petroleum and mining machinery, 4 actual products and one model of general-use machinery, and 4 pieces of textile machinery making an over-all total of 67 varieties of equipment.

The first products seen are the power-producing equipment. On view are a 25,000-kilowatt steam turbine and generating unit, a 50,000-kilowatt steam turbine main shaft, and on both sides are models of the very latest in 120-ton and 280-ton steam boilers. Name plates on the machinery identify them with the Shanghai Steam Turbine Plant, the Shanghai Boiler Plant, and the Shanghai Electrical Equipment Plant. Naturally, this is just slightly representative of the over-all development of the production level of electric power generating equipment made under the direction of the Party.

The main product on exhibit in the western side of the hall is a 930-horsepower exhaust-gas supercharged diesel engine, which is a product of the great leap forward of New China's power-producing machinery plants. It is the first such exhaust-gas supercharged diesel engine produced by the combined efforts of the workers and technicians of these plants. The power of the engine is boosted from 630-horsepower to 900-horsepower, exemplifying the progress which New China's power-producing machinery plants are making toward the attainment of the world's standards. There also is a 170-horsepower diesel engine produced by the Shanghai Machinery and Equipment Plant for use in an 8.6-ton heavy-duty truck. Also, there are Model 4270, 200-horsepower diesel engines representative of the medium-speed diesel engines being used to power electrical generating equipment.

In the series-production products are the 135-series and the 110-series diesel engines. For example, the Shanghai Diesel Engine Plant produces the Tung-feng brand, 135-series in Models No. 6135, 4135, and 12135. All of these are products copied, domestically, from the 110-series diesel engine. Their structure is very advanced, they have good characteristics, their fuel consumption is low, their power-weight ratio is low, and uses are very broad. Such accomplishments show clearly the unceasing rise in the technical levels of the Shanghai Diesel Engine Plant.

Besides those diesel engine products mentioned above there still is a 105-horsepower gasoline engine, which operates at 3,000-revolutions per minute, and will be used in a 3.5-ton truck. Its special points include over-head valves, high horsepower, and good breathing characteristics. The special plants now producing this engine formerly were simply small plants which produced spare parts. Since economic reorganization and technical revolution, they can already produce high-class important power-producing machinery.

Speaking of parts, the 350-millimeter large-scale aluminum pistons and even up to 640-millimeter pistons produced by New China's power-producing machinery plants are of note. This is the first time such large-scale aluminum pistons have been cast in China. They have solved the important problem of parts for large-scale diesel engines. Other automobile parts such as injectors, etc., disclose the success attained, which surpass even several international standards. Also, insofar as the principle of "the whole nation is a chess board" is concerned, it clearly shows that Shanghai is gloriously supporting the entire nation in supplying parts.

The important products located in the eastern half of the hall are metal-cutting machine tools. The first are a series of precision, high-grade, important grinding machines produced by the Shanghai Machine

Tool Plant. They include the Y7125 high-precision gear cutter grinder, which can grind to a surface finish of VVV9. Another is the M8410 roll grinder. This machine is an important part of a rolling mill. It is used to grind the outside diameter of the rolls of a rolling mill. Its total weight is 42,000-kilograms and although it is large it is also precise. Another grinder is the M3317 piston ring grinder. Its precision is completely automatic and is invaluable in the development of the power producing machinery industry. The M8861 bearing-race grinder can be used to grind the bearing surfaces of both roller and needle bearings. It is very necessary in the support of the development of the bearing industry. Its hydraulic power gives it even more latent capacity. The M7120 surface grinder and the aforementioned Y7125 grinder are products which have been sent from China to exhibitions in East Germany.

Other machine tools also show clearly the success of the Shanghai industry. Examples are the 4.5-meter vertical lathe produced by the Shanghai Heavy Machine Tool Plant, which at present is the largest vertical lathe in all of China. It can process a part weighing 20 tons and is completely electrically controlled. The C630 lathe and large-scale roll lathe produced by the Ming-ch'ing Machine Tool Plant, the 6642-model plano-milling machine produced by the Heng-hsin Machine Tool Plant, 262G-model universal boring machine produced by the Shanghai Machine Tool Plant No 3, the 257-model horizontal drilling machine produced by the P'ei-sheng Machine Tool Plant, the Y308 gear hobbing machine for precision instruments produced by the Instrument Machine Tool Plant, and the automatic, precision milling machine produced by the Shanghai Clock and Watch Machine Tool Plant, etc.

Special attention has also been placed on the manufacture of special types of measuring and cutting tools. The new series of tools being produced by the Shanghai Tool Plant clearly discloses the precision and progress made in this field. Utilizing hot-rolling techniques in the manufacture of drill bits and awls can not only conserve steel materials but also raise cutting efficiency and increase the service life of the cutting tools. The following list of new types of hardened-alloy cutting tools clearly shows the progress being made in the field of cutting tools as regards their technology and domestic design. The list includes 5- to 12-millimeter, straight-shank, polished drill bits; 10- to 30-millimeter, tapered-shank, polished drill bits; 10- to 24-millimeter, tapered-shank, "enlarging" drill bits; 30- to 80-millimeter tap drill bits; 10- to 38-millimeter, tapered-shank, reaming cutters; sets of 30- to 100-millimeter reaming cutters; 600-millimeter, "unpolished," surface milling cutters; 10 x 14 three-surface milling cutters; 68-millimeter metal-slitting saw; 19 x 3, half-round, key-slot cutter; 8-millimeter, tapered, key-slot cutter; 110 x 50-millimeter, surface milling cutters, etc.

This same plant also has some new, advanced products in the field of gear-cutting tools and screw-cutting tools. Typical of the products are the 1K-, 1KA-, and 3KA- series, automatically opening and lengthening gear heads and 6- to 10-millimeter hydraulic gear heads. All of these are adequate for the threaded tools of both high-precision lathes and drilling machines. There also are the A-, AA-, and AAA-series hydraulic gear cutters, all of which can be used on high-efficiency lathes and drilling machines. The latter type is a domestically designed product. The first series mentioned can process products to a grade-three finish. The latter series can process gears to a tolerance of 5-microns, which surpasses the English standard in this field. The A-series can likewise process gears within a tolerance of 5-microns. The processing of parts for precision instruments requires the use of such precision tools.

Many of the new measuring tools are the result of the extensive expansion of the machine building industry and its development from ordinary to highly precise products, as well as from never having manufactured such a product to production of same. The various types of gauges which can be manufactured by the Shanghai machine tool and tool industry clearly show the progress made by this industry in the field of precise and high-quality instruments.

General-use machinery and textile machinery has also been greatly developed. Typical of this development is a 12-roll, cold rolling mill produced by the P'eng-p'u Machinery and Equipment Plant. It can roll 0.05- to -.02-millimeter thick steel sheet with a breadth of up to 300-millimeters. This is the first such mill in China. A 4AJ-15 ammonia compressor is the chief product of the Ta-ch'ung Refrigerating Equipment Plant. It has a cooling rate of 150,000 calories per hour at a speed of 720-revolutions per minute. The special point of this piece of equipment is the great saving in steel materials. The Light Industry Machinery Plant has an automatic, 6-mold, bottle making machine capable of making over 17,300 to 69,000 bottles of various types. This same plant has a model 1-5 automatic cigarette packing machine which can pack 83 to 103 packs of cigarettes, containing 20 cigarettes per minute.

The field of textile machinery also clearly shows the progress made by Shanghai industry. The new equipment has much greater productive capacity. The use of automatic casting methods within the textile industry also will greatly increase its ability to become mechanized.



In the corners of the hall are pieces of equipment of special note, namely automatic elevators made by the Shanghai Electric Elevator Plant. Such equipment discloses the 10 years progress by China's elevator manufacturing industry. In the past all such equipment was imported; however, now such equipment can be domestically designed, manufactured, and installed.

One of the things spotlighted in the huge hall are the many types, both large and small, of bearings. The four series of bearings manufactured by the Shanghai Ball Bearing Plant clearly discloses the advancement of the Shanghai bearing manufacturing industry. This industry has progressed from a "have not" to a "have" industry and also recently has innovated automatic production of bearings, such as the automatic production line for type 208 bearings, which was domestically designed, manufactured and installed in Shanghai. A model of this line is at the exhibition for viewing.

The products on display clearly show the new look of Shanghai industry which has been attained in just the last 10 years. They are far superior to the products of the machine industry prior to the liberation and clearly show the glorious and unlimited future of socialist industry.

There also are machine products on the western side of the hall. Of special note is the high-vacuum, diffusion pump produced by the Yung-ku Machinery and Equipment Plant. It can reach 0.000004 millimeters of mercury vacuum and is of special use in the development of the atomic energy and semi-conductor industries as well as the use of such special techniques as vacuum refining, dip-casting, and "mud" molding. Other equipment includes high-vacuum sterilizers and automatic biscuit makers.

Walking from the west side of the hall out into the west courtyard one passes many pieces of communication and transportation equipment, as well as irrigation equipment. There are many high-grade, new-type vehicles for use by the masses. These include the Phoenix brand sedan, which is comfortable, beautiful and speedy. There also are 3.5-ton trucks, 8.6-ton trucks, 27-horsepower tractors, 70-horsepower cross-country vehicles, a three-wheel truck built by the Shanghai Internal Combustion Engine Parts Plant, CSD-CA10-type irrigation pumps, type-R250 treadle mills, etc. Each piece of equipment has its own peculiarities and exemplifies the progress we have made.

The heavy-duty equipment displayed in the west courtyard includes C-1000 petroleum drilling rigs, 650-petroleum drilling rigs, typical of the progress made by the petroleum machinery manufacturing industry.

A domestically designed and manufactured 200-atmosphere-pressure fractionalizing machine is also on display, along with 300-M, three-gear drill bits.

Under the veranda in the west courtyard is an educational exhibit showing the utilization of many advanced experiences and new techniques. A visitor to the exhibition can study the techniques on display to gain new knowledge.

More heavy-duty equipment is to be found in the east courtyard. The first to be seen is a 1,200-millimeter steel rolling mill. The seamless steel tube mill produced by the Shanghai Shipyard is the first domestic seamless tube mill which is automatic. The 4-section ammonia compressor, manufactured by the Ching-yeh Machinery and Equipment Plant, which can produce 2,500-tons of ammonium fertilizer per year is just one of the things produced by the machine industry in support of agriculture. Also on display are the 5-ton forging tongs, so important a part of the first 2,500-ton forging press manufactured in China.

Progress made in the field of mining equipment and machinery is also quite great. Included in the equipment on display are various types of crushers, slurry pumps and drills. There also are high-pressure water pumps, blowers, 2-meter winches, etc. Ten years ago China had no mining machinery or equipment manufacturing industry. Now it is firmly established and promises great future development.

The last 10 years of industrial progress in Shanghai cannot be contained for glowing in such an exhibition as this. Such accomplishments were attained with the assistance of the Soviet Union and other socialist countries.

#### IV. CAST STEEL HIGH-PRESSURE VESSELS

Chi-hsieh Chih-tsao

[Machine Building]

No 9, 25 September 1959, Shanghai

Pages 44-55 (excerpts)

Chinese, per

Shih Tzu-wei

Chou Mei-ch'ing

The high pressure vessel is a key piece of equipment in the chemical and petroleum industries. This is especially true in the chemical industry. A small-scale nitrogen fertilizer plant with an annual capacity of 2,000 tons of synthetic ammonia requires 10 small-scale high-pressure vessels. The establishment of a small-scale nitrogen fertilizer plant in each of the 2,000 hsien of China will require 20,000 high-pressure vessels. An estimate for the Second Five-Year Plan shows that all sectors of the industry will need about 30,000 large and small high-pressure vessels. Such a figure is tremendous.

The development of our chemical fertilizer industry, nationally speaking, is an important task. The use of chemical fertilizer will not only increase the yield per unit area, but will also reduce considerably the use of peasant labor in collecting fertilizer. The conversion of this saving in labor into industrial production, will not only increase the productivity of agricultural materials, but also strengthen the field of industrial manpower.

Since the chemical fertilizer industry occupies such a prominent position in our national economy, the production of the required synthetic ammonia equipment is one of the most important tasks facing the machine industry. The use of cast steel in manufacturing high-pressure vessels is therefore of great importance. However, the difficulties with casting steel in the past, requires that we pay attention to casting steel parts. We all know, at present, that the fractures in cast steel parts are due to its chemical composition and heat treatment or errors in design.

At present there are many pieces of high-temperature equipment utilizing cast steel parts. Some of these are high-pressure cylinders in steam engines and substitution of cast steel parts for steel forgings in many high-pressure valves in the petroleum industry. In the field of high-pressure vessels, forgings are used mainly because of the success of foreign plants, lack of technology, and the ready supply of forging equipment. An East German specialist has said, "When the steel casting problem first came up, everyone was apprehensive, however the

capitalist nations developed steel forging equipment and then the capitalist nations all began using cast steel in manufacturing high-pressure vessels, greatly reducing the utilization of forging equipment. Sometimes when the requirements of the chemical people are too high, forgings must be used. An example of this is the axles on German trains, the Ministry of Railroads wanted forgings but castings will do."

In reality, foreign forged-steel high-pressure vessels exploded. It is difficult to say whether the explosion of the forged-steel vessels was accidental or that the explosion of the cast-steel vessels was natural, isn't it? What we have said is purely for thought. We do not want such an attitude to be adopted toward science; we simply want a deep analysis of the facts to be undertaken and from this the proper route for us to learn the true situation.

Under both central government and municipal directives, the Shanghai Municipal Machinery and Electrical Equipment Bureau, in the period of April to June 1958, organized plants, schools, research units, and scientific organs concerned into a joint effort toward the realization of both the manufacture and testing of cast-steel high-pressure vessels on a broader scale. Units of the First Ministry of Machine Industry, Ministry of Chemical Industry, and Ministry of Metallurgical Industry combined in giving technical assistance. Of special significance was the encouragement and leadership of the Vice-Minister of the Ministry of Chemical Industry and the personnel of the Chiang-nan University who carried out the electrical resistance measuring work. The testing bore results. They clearly showed that cast-steel can be used in manufacturing high-pressure vessels.

In July of the same year, the Ministry of Chemical Industry again held a five day All-China Conference on the Exchange of Experiences in Cast-Steel High-Pressure Vessels. Responsible personnel from both the Ministry and Shanghai chaired the conference, which told of the successes in this field. The ideas of the technicians from some 22 municipal and provincial industrial bureaus, such as Szechwan, Shensi, Tsinghai, Heilungkiang, etc., were exchanged. Discussed were the use of electric furnaces and rotary furnaces, as well as the equipment conditions of the various areas.

The machinery and electrical equipment departments combined on organizing the trial manufacture, testing, and examination of cast-steel high-pressure vessels. Deputy-chief Ch'en of the coke industry department was in charge of this work. It obtained good results which will advance the use of cast-steel high-pressure vessels.

The steel used in the manufacture of cast-steel high-pressure vessels is manganese steel. The special properties of manganese steel are its strength, its plasticity, and its weldability; most suitable to the needs of high-pressure vessels. Manganese steel has been in use in Europe for a considerable length of time, for example the German St-52 steel and the Czechoslovakian LoMn25 steel both are of this family of steels. During the Second World War, because of the shortage of nickel, chromium, and other rare elements, the United States refined NE8020, NE8024, and NE8124 steels, and also members of the manganese-steel group. Since we are so rich in manganese ore, the use of manganese-steel in the manufacture of this terrific number of high-pressure vessels is of great importance to our national economy.

To coordinate discussion and reality, Table No 5, shown below, discloses the results of explosion-testing 5 cast-steel high-pressure vessels.

In the table, the explosion conditions for vessels Nos 2 through 5 are pictured as 1-4, of which the conditions for vessel No 2 are far from actual. Because the vessel turned blue, a test specimen could not be obtained, the table therefore shows the results of heat treatment of a test specimen in so far as the mechanical properties are concerned. The estimate was far greater than the actual.

Vessel No 3, at a pressure of 1,500 atmospheres, split open a small seam and the liquid within the vessel spurted out.

Vessel No 4, because of the low plasticity of its materials ( $\delta_5 = 12-16\%$ ), broke into 5 pieces upon exploding.

Since the materials used in vessel No 5 had good plastic properties ( $\delta_5 = 20-29\%$ ) the conditions of the explosion were good. This clearly shows that the plasticity of the materials which make up the vessel is important. This point far exceeded the estimate. (See table at end of this section)

Since the Yung-li-chu Plant first successfully trial manufactured a multi-layer high-pressure vessel in 1956, more and more interest has been shown in domestic high-pressure vessels. In the short period of four years, trial manufacture and testing facilities have been set up at various places. This has raised the technical level of our domestically manufactured high-pressure vessels and is an important factor in the rapid development of our nitrogen fertilizer industry. However because the techniques involved in the manufacture of multi-layer high-pressure vessels are complex, the work area required is large, cost is high, inspection required for such technical work is extensive and

inspection methods are required for the welding, extensive research into the simplification of technology and work methods in the mass production of multi-layer high-pressure vessels is necessary.

Extensive and complete research and testing clearly disclose that cast-steel high-pressure vessels can meet the previously set design specifications, can be of good quality and can be dependably installed. Their costs are about two-fifths to one-eighth that of a layer-type vessel and their production time is only about one-third as long. Production is comparatively simple and under general equipment conditions can be mass produced. The trial manufacture of cast-steel high-pressure vessels is an important condition in the creation of the nationwide system of small-scale synthetic ammonium-nitrate fertilizer plants, and furthermore, they provide a profitable basis for the development of other sectors of our national economy.

# CONDITIONS FOR EXPLOSION-TESTING FIVE HIGH-PRESSURE VESSELS

Vessel No	$\sigma_b$ kg. per sq. mm.	$\sigma_s$ kg. per sq. mm.	Inside Diameter in mm.	Outside Diameter in mm.	K D/D	Yield Pressure Kilogram/Sq. Millimeter				Explosion Pressure Kilogram/Sq. Millimeter			
						① For-	② Calcu- mula lated	③ Actual Value	④ (3)/(2)%	⑤ Calcu- lated	⑥ Actual Value	⑦ (6)/(5)%	Results
1	56.1	32.6	420	620	1.476	(a) 1208 (b) 1018 (c) 1271 (d) -	1208 1018 1271 -	1200 99.4 118 -	2075 1754 2186 2090	1990 113.5 91 95.2	96 113.5 91 95.2		
2	57 (test rod characteristic)	35.5	300	432	1.44	(a) 1238 (b) 1062 (c) 1290 (d) -	1238 1062 1290 -	1100 103.5 85.2 -	1985 1719 2075 2060	1680 98.2 81 81.5	84.6 98.2 81 81.5		
3	52.5	33	290	417	1.438	(a) 1150 (b) 985 (c) 1200 (d) -	1150 985 1200 -	1150 116.8 95.8 -	1825 1570 1910 1900	1500 95.5 78.5 79	82.2 95.5 78.5 79		
4	40.5	24.5	800	1046	1.308	(a) 641 (b) 589 (c) 658 (d) -	641 589 658 -	630 106 95.8 -	1055 970 1080 1060	920 95 85.1 80.7	87.2 95 85.1 80.7		
5	45.5	24.8	690	910	1.32	(a) 670 (b) 610 (c) 688 (d) -	670 610 688 -	690 103 113 100.2 -	1230 1120 1263 1158	960 85.6 76 83	78 85.6 76 83		

(a) First strength formula  $P = \sigma \cdot \frac{K^2-1}{K^2+1}$ ; (c) Plasticity formula  $P = \sigma \cdot \ln k$ ;

(b) Fourth strength formula  $P = \sigma \cdot \frac{K^2-1}{\sqrt{3}K^2}$ ; (d) Plasticity explosion formula  $P = \frac{2}{\sqrt{3}} \sigma_s \left( 2 \frac{\sigma_s}{\sigma_b} \right) \ln k$ .

V. GREAT ACHIEVEMENTS OF THE MACHINE INDUSTRY  
IN THE PAST DECADE

Chi-hsieh Kung-ch'eng Hsueh-pao  
[Mechanical Engineering Journal]  
No 1, 30 September 1959, Peiping  
Pages 1-4  
Chinese, Per

Liu Ting  
Vice Minister, First  
Ministry of Machine  
Building

Ten years is a short period in the history of mankind. Notwithstanding this short 10-year period, the liberated Chinese people under the glorious leadership of the Chinese Communist Party and Chairman Mao Tse-tung have attained heretofore unattainable successes. China's machine industry has made similar accomplishments. It has developed greatly. In the 10 years of New China's machine industry history, it has far surpassed the progress made by old China in over 100 years.

New China's machine industry has developed from nothing to what it is today. Old China had nearly 100 years of history but this long period was spent under the oppression of Imperialism, Colonialism, and Capitalism. Industry could not develop. The machine industry, it can be said, was only a "piece of white paper." The few machinery plants which could survive were only colonial type repair enterprises. They could only repair or manufacture the parts for machinery imported from imperialist countries. The Japanese imperialists, in order to plunder and gradually encroach upon China, established machinery plants in the Northeast to produce military items or repair transportation equipment and mining equipment. The American imperialist, under the guise of "assistance," which really was plunder, controlled Shanghai's industrial machinery manufacturing companies and built some machinery. The KMT-controlled plants, outside of producing weapons, produced few other machines. The Chinese capitalist-controlled small plants had little opportunity to develop. Old China's machine industry suffered long and hard under the plundering of the Japanese and American Imperialists and under the weak KMT government prior to the liberation. For example, a plant established in China long ago, the Chiang-nan Shipyard, was Old China's largest machinery plant, however, when we gained control of the plant there was nothing in it. The workers had stripped it, leaving only the four walls. The machinery had either been taken or destroyed by the KMT reactionaries.

When we began our construction after the liberation, we could not help but encounter difficulties due to the former Imperialism and Feudalism. For instance there was a shortage of equipment and a lack



of technical skills, etc. However, no difficulty is too much for the Chinese people. Under the leadership of the Party and with the assistance of the Soviet Union and other brother socialist nations, we overcame the difficulties in the path of our progress. The period of 1949 to 1952 was a long struggle of restoration. However, the machine industry was restored and in 1953, our First Five-Year Plan actually went into effect. This began a large-scale construction task. In the past 10 years, the machine industry has constructed numerous hundreds of technically equipped, modern, large-scale enterprises. Simultaneously with the construction of the large-scale enterprises, medium- and small-scale enterprises have appeared all over China like bamboo shoots sprouting up after a rain. The capital construction and newly added fixed capital are many times that of the hundred years of Old China's machine industry. The large-scale capital construction has changed the whole of the machine industry. It has not only greatly increased the industrial production capability, but has also changed the old and irrational distribution of industry. Also of importance is the establishment of a number of industrial departments which formerly did not exist, for example the metallurgical equipment manufacturing industry, the electrical generating equipment manufacturing industry, the mining equipment manufacturing industry, the oil-refining and chemical equipment manufacturing industry, the aircraft manufacturing industry, the automobile manufacturing industry, the tractor manufacturing industry, the machine tool manufacturing industry, the instrument and meter manufacturing industry, the radio manufacturing industry, and those for measuring and cutting tools, bearings, abrasives, etc. Simultaneously with the great progress in capital construction, the machine industry made improvements in organization and technology. With such a material and technical basis the fervor of the working masses was increased and the total value of production of our machine industry made a "flying leap forward." It showed a 3,000 percent increase during 1958 as compared to 1949. It averaged a 46 percent increase per year. In 1949 the total value of production for the machine industry accounted for 6.8 percent of the total value of production for the entire national economy, while in 1958 this was increased to 15.8 percent.

The speed with which the output of the machine industry has increased is overwhelming. The comparative increases in output of certain important products during 1958 as compared to 1949 are listed below: AC electric motors, 138 times; power-producing machinery, 200 times; and metal-cutting machine tools, 31.6 times. Such important products as metallurgical equipment, chemical equipment, electrical generating equipment, automobiles, tractors, aircraft, etc., cannot be compared with Old China since Old China could not manufacture such products in the past. These businesses have all made great progress during the last few years. During the great leap forward of 1958, the output of

metallurgical equipment reached 150,000 tons, a 300 percent increase over the total value of production in this field during the entire First Five-Year Plan; the output of electrical generating equipment reached 800,000-kilowatts, an increase of 400 percent over the output of 1957. There would be even greater increases if the figures for the post-liberation were compared to the output figures for Old China.

The speed of the development of China's machine industry, not only is far greater than that of Old China, it is also coveted by the capitalist nations. In the last 10 years, China's industrial production has increased 30 fold, while that of the United States and Britain has increased only 1/2 to one fold. Not only has the actuality of China's rapid industrial development increased the interest of the people toward socialism, but it has also daily increased the world's skepticism of capitalism. Moreover, it can positively be stated that only under socialism could such an industrially backward country, in just a short period of time, surpass capitalist nations.

Another facet in the rapid development of China's industry has been the equally rapid rise in its technical levels. Everyone knows that in Old China the technical levels of the machine industry were very low. Not only could it not supply the equipment necessary for the heavy industry but it also forced most of the equipment for light industry to be purchased from abroad. However, in the short period of 10 years since the liberation, this backward colonial concept has been changed. China's machine industry has already begun to develop toward satisfying all the needs of the entire national economy. For example, the newly constructed heavy equipment manufacturing industry can already manufacture 750/550 millimeter blooming mills with annual capacities of 400,000 tons, 2,500 ton hydraulic forging presses with annual capacities of 160,000 tons which can forge 40 ton steel ingots, and 1,513 cubic meter blast furnaces with capacities of 350,000 metric tons of pig iron per year. In the field of electrical equipment and power-producing equipment we can already produce 25,000-kilowatt and 50,000-kilowatt steam turbogenerator units. A 72,500-kilowatt unit is built and is being transported to the Hsin-an-chiang Hydroelectric Power Station. Various types of electrical equipment and electrical materials can also be manufactured. In the fields of communication and transportation equipment, we can already manufacture the most modern trucks, electric locomotives, internal combustion locomotives, and the newest types of jet aircraft. A 10,000-ton class ocean freighter is now in construction. The machine tool industry, in order to form a basis for the machinery industry, can already produce large and precision machine tools such as 3.4-meter vertical lathes, 3-meter wide and 14-meter long plano-milling machines, precision screw-cutting lathes, highly precise jig-boring machines with tolerances of 0.006 millimeters,

very precise gear grinders, etc. In the field of agricultural machinery, we have already successfully manufactured tractors and combine-harvesters, seeders, and new types of machine-drawn farm implements. To satisfy the needs of the peoples' livelihood, in this ten years we have manufactured various kinds of light industry machinery and equipment such as textile machinery, sugar-making machinery, paper-making machinery, medical equipment, various types of radio receivers and television sets, etc. In the successful trial manufacture of these numerous new products, the percentage of domestic design has been raised. At present, we cannot only domestically design general machinery, but also heavy-duty and precision equipment. The rapid development of trial manufacture of new products not only discloses the increased level of technology within our machine industry, but also is important to ensure that the technical equipment required by the other sectors of our economy are unceasingly supplied.

In the past 10 years, China's machine industry has established many scientific research organs, product design organs, plant design organs, and higher grade institutions for the training of the technical manpower needed by the machine industry. Many more production enterprises have already established central testing laboratories. The establishment of such organs and institutions provide good conditions for the rapid rate of development of the machine industry.

In its development, China's machine industry has put great emphasis on the use and expansion of new techniques and advanced technological methods. Examples of this are the increased use of electro-slag welding, the increased use of lost-wax casting and other precision casting methods, increased use of nodular cast iron in the last few years, the increased use of various metallurgical and non-cutting processes, the expanded use of high-speed cutting, stronger cutting and advanced types of cutting tools in many plants, and the testing of electric processing is being carried on in many places. Along with the attainment of the world's advanced technology, we have also, ourselves, created many experiences and methods. Examples of these are the "ants gnawing at a bone" technique of using several smaller machine tools to do the work on a large part. The use of an old Chinese casting method called "mud" casting is being newly developed. From the technical standpoint, the use and expansion of these new techniques and advanced technology will ensure the rapid rate of development of the machine industry. In the short period of ten years, China's machine industry has changed its backward conditions until now it is capable of advancing at the world's most advanced levels in the fields of heavy-duty, large-scale, precision and important equipment. Such a fact clearly discloses that since the thorn of capitalism was plucked from our means of production, there has been no resistance in the expanded use of advanced experiences. Such has never before been possible in any society.

Together with the great leap forward in production, the ranks of the machine industry has rapidly expanded. In the period of 1949 to 1958, the ranks of the machine industry increased over ten fold. The workers became the plant leaders and the masters of their equipment. They brought forth their latent creativeness and raised their productivity. The rapid climb in their productivity and the growth of their ranks effectively ensured the rapid development of the machine industry. The Chinese workers not only have no danger of losing their employment, but they have also attained great material increases, higher cultural levels and improved working conditions. There is no basis of comparison in these respects with the workers of the capitalist nations.

Why have we, in the short period of just ten years, been able to surpass the hundred years of history of Old China and the several tens of years of the capitalist nations? Everyone knows that for a long time Old China's machine industry was without development. It lacked manpower, material investment and machinery and equipment. Our nation is rich in minerals, needing only mining and refining equipment. We have vast water power requiring only electric power generating equipment, our numerous rivers and long coast lines require transportation equipment, the land area we have requires trucks, tractors, and farm implements, and furthermore the people of the People's Republic of China need light industry machinery to improve their living conditions. However, in the semi-colonial society of Old China this could only be thought about. In 1945, in his "Discussion of A Unified Government," Chairman Mao stated: "Without independence, freedom, democracy and cooperation, the proper type of large-scale industry cannot be established." The history of China clearly shows that only under a socialist society can the long-range dreams of the people of China be realized.

The most basic assurance of the development of the machine industry of China is the leadership of the Communist Party and Chairman Mao. The concept of the development of heavy industry first has placed great emphasis on the development of the machine industry and has made it the most important link in the socialization of our industry. The Party established "main line" and the principle of "walking on both legs" are the main ways which the rapid development of the machine industry can be achieved.

The great achievements of the past ten years by the machine industry of China are also the achievements of the Chinese Communist Party's mass line. Marxism-Leninism has shown that history is created by the masses and that the people are the basis of production. Revolution and construction are necessarily undertaken by the masses. The masses of the Chinese people want to rapidly change the backward effects left over from the old society. They want to develop production, socialize industry, and establish a Communist society. The workers of

the machine industry are the same as the workers of the other sectors of our economy, they implemented socialist labor methods and advanced producer movements in order to overfulfill the First Five-Year Plan. In 1958, under the glorious "main line," the machine industry banded together in a mass movement. Not only in the large cities did many machinery plants appear, but also in special districts, autonomous regions, and hsiens were small machine repair plants established. This is a great incident in the history of China.

The great successes of the Chinese machine industry could not have even been started without the unselfish assistance of the Soviet Union and other brother socialist countries. In the past ten years, the Soviet Union has directly assisted us in constructing and equipping several tens of large modern enterprises. In the construction of these enterprises the Soviet Union unselfishly undertook the complete selection of the plant site, gathering of materials, survey work, supply of complete sets of equipment, drawing technical documents, direction of the construction, and finally the actual start of the production. For instance, the Automobile Manufacturing Plant No 1, which they assisted in constructing, required the use of some 26 Soviet design organs and more than 100 machinery manufacturing plants in its design and equipping. Many of the pieces of equipment used in the plant were of the very latest types. For instance, the Soviet Union supplied the 30,500-ton mechanical press installed in the plant. It was the first such piece of equipment in existence. Furthermore, the USSR trained many personnel and sent specialists to carry out supervision. We sincerely thank the USSR and the other socialist countries for their unselfish assistance to our nation.

The success attained on the "battle line" of the machine industry during the past ten years is unprecedented in history. However, we still are very inexperienced. Our machine industry still is a long way from satisfying the demands of our socialist construction. The present-day Chinese machine industry is a restored and changed industry compared with that of Old China and this is only a beginning. We therefore must exert great effort to this end.

VI. OPPOSE RIGHTIST TENDENCIES, STIMULATE HARD WORK,  
LEAP FORWARD ON ALL FRONTS

Tien-chi Kung-yeh

Editorial

[Electrical Equipment Industry]

No 16, 29 August 1959, Peiping

Page 1

Chinese, per

In the first seven months of 1959, on the basis of the great leap forward of last year, the electrical equipment industry attained new great successes. As regards product output, generating equipment was 3.87 times that of the same period of 1958, AC electric motors were up 3 times, and transformers were up 2.45 times. Such facts clearly show that the employees of the electrical equipment industry are continuing to advance.

However, while gaining such successes, there still are several problems. These are that product diversification is not evenly distributed. Certain large and difficult-to-manufacture products, which also are urgently required by our country, such as large-scale electric motors, AC electric motors, special type electric motors, high-voltage electrical porcelain, explosion-proof electrical equipment, etc., are inadequately produced. Product quality and production technical processes have already undergone revision but still require stabilization and raising. The utilization of circulating capital by some of the enterprises has not been decreased and even in some cases increased. Of special alarm to us has been the last two months' production which has successively decreased.

How can such a phenomenon be?

Some people say: "Material is in short supply, which lowers production." In the over-all picture, short supply of materials is not a large problem, however, there are certain difficulties in various products. Take steel materials for instance. The stored steel materials at many of the enterprises has not been decreasing, but on the contrary, has been increasing. The conditions in the field of material supply for the months of April and May were better than for the first quarter of 1959. Such tendencies on the part of the leadership cadre as irrational utilization of materials, not strengthening management, waste of materials, etc., must be overcome. The masses must be mobilized and every way utilized to enable our nation's limited supply of materials to be adequate for production. This is an important factor in the completion of the entire year's plan.

Some people say: "The reform of product quality has reduced production." Generally speaking, the period of reform in product quality possibly did affect production, however, as a result we can raise quality and quantity at the same time. An actual example follows: the Chia-mu-ssu Electrical Equipment Plant in its drive to reform product quality raised production during June by 4.3 percent over May, and during July raised it 4.3 percent over June. Therefore, mobilizing the masses, reforming product quality and production technical processes and establishing several necessary systems were important factors, formerly, in raising product quality and increasing production. Many of the ideas and methods were erroneous. Henceforth, the principle of "more, quicker, better, and cheaper" must be utilized.

Some people feel that since the plan has been reduced they don't need to put forth much effort. Comrades, such a concept is not realistic. Compared with the first half of this year there still remains a tremendous task to be completed in the last half of the year. Great effort must be expended in the fields of large-scale and technically complex products so that the entire plan will be completed in the next five months. Reform of product quality, and production technical processes still must be started in many enterprises. Difficulties and problems still remain in the field of materials as regards production capabilities and variety of products available.

At present, the electrical equipment industry is engaged in developing higher production, quality, and lower costs -- all important factors in the movement for increased production. Various units must encompass the entire national plan in their efforts to set unit and individual targets. Directives must be adopted for certain key problems and weak "links." Great successes can be attained if the foregoing are adhered to.

VII. STRENGTHEN ADMINISTRATION OF ENTERPRISES,  
IMPROVE QUALITY AND OUTPUT

Tien-chi Kung-yeh  
[Electrical Equipment Industry]  
No 16, 29 August 1959, Peiping  
Pages 7-8  
Chinese, per

Bureau No 8 of the First Ministry of Machine Industry opened conferences at Harbin, Shanghai, and Mukden during the first part of July. The conferences were concerning the two letters which Minister Chao of the First Ministry of Machine Industry had written concerning the quality problem, and also, important work directives concerned with the last half of 1959 were studied. The success attained during the great leap forward were discussed, exchanges were made concerning reform of enterprise management, experiences in movements to raise product quality were developed, and movements to raise output while raising quality, and reforming techniques were demanded of the enterprises. The aim of all these movements and exchanges was the fulfillment of the national plan on the principle of "move, better, faster, and cheaper."

The conferences pointed out the greater successes attained by the electrical equipment industry since the great leap forward of 1958. The total value of production for the industry increased about 1 1/2 times that of 1957, generating equipment increased over 4 times, electric motors increased 3 times, transformers increased 2 times and the total number of employees within the industry increased about 2 times. At present, excluding Tibet, every province has an electrical equipment manufacturing plant. Last year, with the aid of the trial production of a 25,000-kilowatt steam turbogenerator unit, a 220,000-kilovolt transformer, as well as other types of large new equipment, the technical level was raised very greatly. In the first half of this year the output of generating equipment was up over 4 times that of the same period of last year and the output of electric motors was up over 3 times the same period last year. The production of important products as a whole showed a great increase over the corresponding period of last year. This is a continuing leap forward based on last year's great leap forward.

However, management has not kept pace with this great development of production. There are enterprises the production processes of which appear to be quite confused. The quality of certain products has been lowered. With the progressive reform undertaken during the first half



of this year, product quality has already shown a rise, however, as it is, there are a few products which have not attained their past levels. Quality still remains to be continuously developed. The confused state of the production of some enterprises is on the way to rectification. The conferences emphasized that if this condition is not rectified there is danger that there will be a definite effect on the completion of this year's plan.

The conferences recognized that there were several basic reasons effecting quality. The most important, however, is the thinking of many comrades and the lack of concerted effort. At present, there still are some comrades who lack a deep knowledge of the reform of product quality. After criticizing this rightist conservatism, the conferences pointed out that all products must be put into production under proper technical conditions and the finished products must meet technical standards in order to leave the plant. By protecting product quality, production can be raised, costs lowered, and labor productivity can be raised.

The task for the last half of the year is great. Such an opportunity cannot be lost, for such a time as this may never come again. Therefore, it is necessary to continuously and rapidly mobilize as dictated by this opportunity. The conferences requested the enterprises to carry out conscientious inspection of the quality of their products in order that the concept of the principle of "more, better, faster, and cheaper" could be completely understood by all the employees of the various plants. During this reform, necessary organization and systems must be established to enable the production processes to operate in a correct fashion at an early date and also to enable the quality of the product to be rapidly raised. The conferences levied different requirements based on the different conditions of the various plants. To plants which have undergone technical reform and now have comparatively good production conditions, the conferences required that the quality of product be raised to the highest past level within three months and at the same time the necessary work for the strengthening of economic management must be undertaken. To plants which have been in production for some years, but which have not been technically reformed, it was requested that they study the experiences of older plants to overcome the dissimilar technical conditions, work conditions, and management conditions inherited by the consolidation of many smaller plants. Newer plants which on the one hand are still being constructed while on the other hand are in production should of most importance strengthen production technical preparations, undergo trial production of new products, raise quality, and nurture correct production practices. The conferences further pointed out that the enterprises should carry out inspection of materials and semi-finished products to strengthen accounting, strengthen management, and reduce the accumulation of capital.

The conferences fully realized that if the raising of product quality is to be the heart of the matter, then the reform of production processes must be carried out under the leadership of the party and with adherence to the experiences gained by use of the "general line." It must also be carried out in close cooperation with existing movements. Experiences already gained show problems exist in technical inspection and in technological reform work. The reform of the various types of management now existing within the enterprises requires a clear picture of the principles involved in various strata of leadership, mobilization of the masses for participation in management, and the strengthening of worker cooperation in management. According to experiences gained by the Shanghai Electrical Equipment Plant, this must be done on the basis of relationships in the following four sectors: bureau-ministry, long range-short range, present-past, and internal-external. On such a basis it is the responsibility of the plant chief to establish the correct production system. In such a manner, the correct system of production will emerge and will act as a basis for the establishment of product quality. Individual methods of reformation cannot be undertaken. The "san-chi-ho" method should be adopted as well as mass discussion, and then clearly carried out.

These conferences requested that the various plants draw up a plan on the basis of central government and First Ministry of Machine Industry directives. To help the various plants quickly raise the quality of their products, the conference held at Shanghai designated several plants to act as "center" plants. They will be responsible for the fabrication of a system of supply of materials for the other plants and also for the forming of classes for the training of personnel for product inspection. They will also help the other plants in testing new products and in solving technical problems.

# VIII. GAINING EXPERIENCE FROM A COMPARATIVE ANALYSIS OF THE QUALITY OF ALL MEDIUM- AND SMALL-SCALE ELECTRIC MOTORS

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[Electrical Equipment Industry]  
No 16, 29 August 1959, Peiping  
Pages 17-19  
Chinese, per

## A. General Conditions

Nationally speaking, the production of medium- and small-scale electric motors is great and its effect on the national economy is very widespread. Since the great leap forward in 1958, there has been a "flying leap forward" in the manufacture of medium- and small-scale electric motors. The construction of new electrical equipment manufacturing plants is like bamboo shoots popping up after a spring rain. During December 1958, Bureau No 8 of the First Ministry of Machine Industry organized an inspection of the quality conditions on a nationwide scale, as well as the new productive capabilities available, in No 3-No 9J and JO-type electric motors. It was desirable that this critique would spur the concerned units on to greater quality consciousness and moreover, through the adoption of directives, to effect a great leap forward in both the quantity and the quality of medium- and small-scale electric motors.

The work was under the chairmanship of the Medium- and Small-scale Electrical Equipment Research Laboratory of the Shanghai Electrical Equipment Scientific Research Institute with eight "center" plants, namely the Nanking Electrical Equipment Plant, the Hsiang-t'an Electrical Equipment Plant, the Dairen Electrical Equipment Plant, the Kunming Electrical Equipment Plant, the Shanghai Rotary Electrical Equipment Company, the Sian Chung-kuang Electrical Equipment Plant, the Peiping Electrical Equipment Plant, and the Canton Nan-yang Electrical Equipment Plant, sharing the responsibility within eight separate districts. This critique was undertaken on a wide scale. Participating were 93 plants of 23 provinces and 2 municipalities. These included old plants with comparatively great experience in such manufacture and some were plants which had just begun the manufacture of such equipment. The number of pieces of equipment in the J and JO-types which are in trial manufacture totaled 204 pieces. These ranged from No 3 to No 9 and from 2- to 6-pole types. Capacities ranged from 0.6- to 100-kilowatts. All of this indicates the extent and diversification of the products under consideration.

The standards for this critique are the technical conditions for electric motors promulgated by Bureau No 8 of the First Ministry of Machine Industry for J- and JO-type three-phase, induction electric motors (ODG510,000). However, there are many new plants participating in the critique and there is a wide range in the extent of their equipment conditions. Many lack manufacturing experience. Their products were produced with a shortage of technical help and often their first product was submitted for criticism.

The results of the critique disclosed the following important problems in electric motor quality:

1. Eighty-five percent of the machinery was assembled with dimensional errors. Examples of this are: some electrical equipment had centers which were 10-millimeters higher than standard; the diameter of some of the armatures were oversize and some were undersize; the width of key slots were not standard and in some cases key slots were even lacking. These violations were noticeable in both old and new plants despite the difference in engineering skill.

2. Air cracks were not uniform. Using the northeast district as an example, over 72.8 percent of the equipment had air cracks 20 percent over the average. Generally, 40 to 60 percent of the pieces were not uniform.

3. Thirty-one and two-tenths percent of the equipment analyzed exceeded high-temperature standards. Of these, many exceeded the limit by 8 degrees Centigrade and the highest attained was 170 degrees Centigrade.

4. Problems in low efficiency rates plagued 27.4 percent of the equipment tested. The copper-loss values for stators, in general, was about 200 percent of the original designed value; iron-loss values exceeded the originally designed values by 50 percent and even as much as 400 percent; the copper-loss values of some of the rotors reached even to 800 percent.

5. Problems in working coefficients were found in 24 percent of the cases. For example, a J42-4 electric motor used a current of 5.8 amperes when unloaded (fully loaded it used 6.1 amperes), also, another of these J42-4 motors had air cracks of 0.98 millimeters (the design called for 0.3 millimeters).

6. Voltage puncture. Problems concerning this accounted for 17.9 percent and caused punctured insulation and short circuits between the coils and the case.

7. Other problems concerned low starting rates, high vibration, and high starting currents.

There were other deficiencies which, although not appearing to be great problems, nevertheless made themselves felt in the performance of the electric motors and were in reality quite large. Examples of such problems were improperly fastened silicon plates, etc. Such problems were apparent in all localities tested. Some times these problems could cause breakdowns.

From this critique it can be seen that the development of the medium- and small-scale electric motor industry during the past year has been shocking. The initial stage of development has been completed, but many newly constructed electrical equipment manufacturing plants are inadequate insofar as equipment and investment are concerned. They are also laboring under conditions of inadequate technical capabilities and lack of manufacturing experience. However, through communism, they have produced large amounts of electrical equipment to supply the needs of all sectors of industry. Moreover, many of the new plants have very good quality products. Take for example such plants as the Nanking Ku-lou Electrical Equipment Plant, the Sung-kiang Electrical Equipment Plant, the Ch'ang-hsia Municipal Electrical Equipment Repair and Manufacturing Plant No 1, etc., which were new plants in 1958 (newly established or converted). Of special significance was the plant at Ch'ang-hsia, for its equipment was very simple and its technical capabilities were weak. This clearly shows that through concerted effort, quality electrical equipment can be manufactured. According to the conditions prevailing at present in our trial manufacture of electrical equipment, great effort must be put forth to raise the quality of such products.

## B. Basic Analysis

In order to clarify the problems in question, four important deficiencies in the field of electrical characteristics underwent analysis.

### 1. High temperature: important reasons follow:

a. Electrical equipment has many shortcomings. Sources of internal heat have increased.

b. Incorrect lacquering. Some pieces are lacquered only once. Some plants do not pay attention to the temperatures of the baking kilns and the lacquer consequently develops internal weaknesses. On electrical equipment which has been improperly lacquered the temperature may be 3-5 degrees centigrade higher than on equipment which has been properly lacquered. In special cases the temperature may even be as much as 15 degrees more.

c. Few design changes have been made to change the cooling structure of the equipment. The cool air blast on medium- and small-scale electric motors has a great effect on the temperature of the equipment. For instance, in the past the temperature of J42-4 electric motors produced by the Hsiang-t'an Electrical Equipment Plant far surpassed the temperature standards set for it. After Soviet experts changed the angle of the blower blades, the temperature became satisfactory. Other causes were due to carelessness or errors on the part of the manufacturing plants.

2. Low efficiency: important reasons follow:

a. One of the reasons for the great copper-loss in the rotors is lack of control in the temperature and speed of casting aluminum so that the aluminum parts contain internal air bubbles and weaknesses. The lack of ability in welding copper parts and also the poor quality copper used also creates high copper-losses in rotors.

b. Great stator copper-loss. Some plants, because of material shortages, utilize improper wiring and create high resistance within the stator.

c. The great iron-losses are due mainly to the poorly rolled iron sheets, etc. In some plants only the length of the armatures receive attention; the weight is of no importance. The plates are also located too far apart. Another reason for great iron-losses is materials used. At present there is a shortage of silicon-steel sheet, hence some plants utilize black-iron sheets as a substitute. However technologically speaking, it does not have the desired characteristics. Some plants even use unquenched silicon-steel sheets and consequently have a higher iron-loss.

d. Mechanical shortcomings are many. The mechanical shortcomings of small-capacity electric motors is comparatively great. This is especially true in two-pole motors. The most important reason is improper mechanical processing and poor quality assembly. The mechanical shortcomings of some plants exceed the design value by 900 percent.

3. Work factors were lower than standard. The following reasons were extracted from analyzing the results of testing:

a. Many burrs on the sheets and unequal pressures resulted in the armatures produced by one of the plants weighing only  $\frac{4}{5}$  of the designed weight. Also, the large amounts of burrs require a great deal of grinding.

b. The mechanical processing of the outside diameter of the rotor is too little.

c. Stator and rotor do not match.

4. Voltage puncture: main reasons given below:

a. The most important reason is the great number of new workers who have not received adequate education on the importance of quality in their products, hence, when they are on the production line, if a part does not fit they frequently strike it with a hammer forcing it to fit but damaging the insulation.

b. Improper insulation, such as one-coat lacquering, improper use of insulating paper, and due to the lack of materials, the use of makeshift substitutes are factors. Also some plants, when installing paper insulation in coils, use paper which is far beneath the required standard strength.

Through the analysis of the above-mentioned series of electric motors, one can clearly see the basic reasons for lack of quality. The following is a list of these basic reasons:

1. Production technology problems: Most of the plants which participated in the critique were producing according to old plans so there were few problems concerning design as related to quality; however, there were many problems in technology. The four key problems in technology are listed below:

- a. sheet rolling
- b. machine processing
- c. insulation
- d. aluminum castings for rotors

2. Technical material supply problems: This is the main problem confronting new plants. Not only do plants lack materials, they also lack ability to utilize them. The critique disclosed that many plants did not know the technical conditions as outlined by the Bureau.

3. Many new workers and low technical levels: Since the great leap forward, plants have added many new workers, generally, over 50 percent of their working force. Some of the new plants can even say that 100 percent of their employees are new hands. These new workers are enthusiastic, but are technically limited and create quality problems. As a result, classes to raise their technical levels must be quickly established, as quality is presently the "key" problem.

4. Technical management problems: Since the great leap forward of last year, many old regulations were destroyed. With the construction of so many new plants, new regulations have not been established. The most important factors in the present situation in the technical management and production of both old and new plants is as follows:

a. Inspection standards have been established but in many key spots they have not been manifested.

b. In many plants, because of the limited equipment, new products are not tested, but immediately put into batch production. In some of the new plants, products even leave the plant without a test.

c. Some of the technical regulations of old plants were destroyed. Those not destroyed remain in effect. In many of the new plants there are not technical regulations, the workers don't even know what a technical regulation is. They carry on individually.

d. During last year there was a variety of conditions under which the plants worked in order to solve the material supply shortage. The practice of not analyzing tests before production is begun is still an important factor in many new plants.

5. The principle of "more, better, faster, and cheaper" is not a universal concept. Since the great leap forward, the desire for electrical equipment has increased from all sectors. The trial manufacture of new products has become a great task. Some plants, due to the increased burden, have become careless in quality and hence it has been easy for production standards to lower.

6. Another of the main reasons for the poor quality of electrical equipment is the poor quality of the raw materials used in their manufacture.

#### C. Ideas on Raising Quality

The following list of ideas has been put forth in an effort to solve the aforementioned problems:

1. Leadership is important. Greater use of the masses and strengthening of the relationship between them and the leadership should be attempted.

2. Establishment of a system of inspection.



3. Use old, correct drawings in production in order to ensure electrical equipment quality.

4. Products which leave the plants must meet technical standards. They must undergo testing and new products must be tested prior to going into production. Also any changes in techniques, materials, or design must also be tested.

If the manufacturing plants do not have the facilities to carry out the testing, then the province or municipality should establish a testing station of adequate capacity. At the same time, to ensure standard measurements, a provincial or municipal measuring station should also be established.

5. A comparatively ordinary problem at present is equipment which is not precise enough to maintain design standards or is not properly controlled to do so. It is suggested that each plant, on its own initiative, take steps to solve its own shortcomings in this respect and if necessary to receive technical assistance from related units.

6. Expand and establish a complete network of technical reporting and supply of drawings.

7. Under the present conditions of the many new employees, the establishment of technical regulations is especially urgent. It is suggested that all plants strive toward this end.

8. Plants should exchange experiences gained in production so that all can use the very latest in techniques.

9. A quality critique is an important method in raising the quality of products. In areas where conditions are favorable each province should establish a central station. Where conditions are not favorable, several provinces can cooperate in the establishment of such a station. In the future, critiques can be handled by the provinces, themselves. Provincial critiques will be organized by the provincial management bureau, one or two times each year. A national critique based on the provincial critiques will be held once each year.

10. It is suggested that the various industrial bureaus organize technical experience exchange conferences. Included would be the experiences in training new employees to a higher technical level.

(This material was extracted by this magazine from "A Report on the All-China Critique of No 3-9, J and JO-Type Electric Motors," published by the medium- and small-scale electrical equipment research laboratory of the Shanghai Electrical Equipment Scientific Research Institute, May 1959.)

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